4/9/18 "The strength to win comes from within."-Anonymous

HW: "Horizontal Stretching of functions" homework section

Quarter Test Thursday 4/12

AIM: How do we recognize a horizontal stretch?

Warm Up:

$-2 \leq y \leq 8$

The function h(x) has a range (y) given by the interval [-2, 8]. The function f(x) is defined by $f(x) = \frac{1}{2}h(x) + 6$.

What is the range of f(x)?

$-2 \times \frac{1}{2} = -1 + 6 = 5$

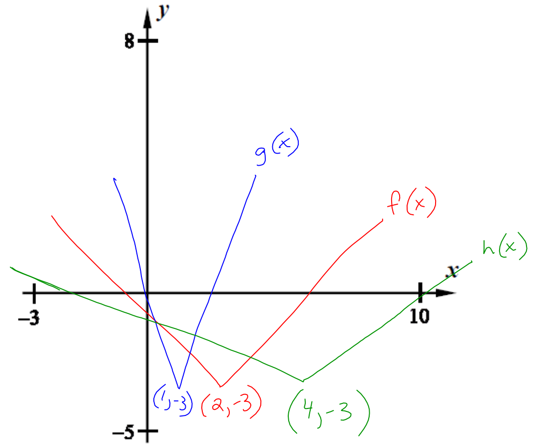
$8 \times \frac{1}{2} = 4 + 6 = 10$

$\boxed{[5, 10]}$

$|x|$ right 2 down 3

***Exercise* #1:** Consider the absolute value function $f(x)=|x-2|-3$.

(a) Using your calculator, sketch a graph of f on the axes provided. Label the coordinates of its vertex point without the use of your calculator.



(b) Consider the function $g(x)=f(2x)$. Determine a formula for g and then graph it on the axes. Use your calculator to find its minimum point and label it on the graph.

$f(x)=|x-2|-3$

$f(2x)=|2x-2|-3$

$g(x)=|2x-2|-3$

Minimum point

$(1,-3)$

(c) Now consider the function $h(x)=f\left(\frac{1}{2}x\right)$. Determine a formula for h and graph it on the axes. Use your calculator to find its minimum point and label it on the graph.

$f(x)=|x-2|-3$

$f(\frac{1}{2}x)=|\frac{1}{2}x-2|-3$

$h(x)=|\frac{1}{2}x-2|-3$

(d) Summarize your findings below for each function.

$f(\frac{x}{2})$

$f(x)$ turning point:	$f(2x)$ turning point:	$f\left(\frac{1}{2}x\right)$ turning point:
$(2,-3)$	$(1,-3)$	$(4,-3)$

(e) What stayed constant about the turning points? What changed and how did it change?

The y-value Stayed

The x-values changed by doing the inverse (opposite) of what it showed

HORIZONTAL DILATIONS

For a real number, positive constant such that $k > 1$:

1. The function $f(kx)$ represents a horizontal compression of $f(x)$ by a factor of k
shrink

2. The function $f\left(\frac{1}{k}x\right)$ represents a horizontal stretch of $f(x)$ by a factor of k.

a b c

Exercise #2: Let's take a look at the **quadratic function** $f(x) = x^2 - 12x + 20$.

(a) Determine the coordinates of its turning point by using the equation for the axis of symmetry of $x = -\frac{b}{2a}$.

$x = \frac{-(-12)}{2(1)} = \frac{12}{2} = 6$

$a = 1$
$b = -12$
$c = 20$

$f(6) = 6^2 - 12(6) + 20$
$= 36 - 72 + 20$
$f(6) = -16$

$T.P. = (6, -16)$

(b) If g is defined by $g(x) = f(3x)$, what should be the coordinates of its turning point based on our previous work? Explain.

divide x-value by 3

New T.P. = $(2, -16)$

(c) Determine a formula for $g(x)$ and then use the turning point formula to verify your answer from part (b).

$g(x) = f(3x)$

$g(x) = f(3x) = (3x)^2 - 12(3x) + 20$

$\boxed{g(x) = 9x^2 - 36x + 20}$

a b c

$x = \frac{-b}{2a} = \frac{-(-36)}{2(9)} = \frac{36}{18} = 2$

$g(2) = 9(2)^2 - 36(2) + 20$
$= 36 - 72 + 20$
$g(2) = -16$

$T.P. = (2, -16)$

(d) Show that the y-intercept of both $f(x)$ and $g(x)$ are equal. What does this make sense from a horizontal dilation perspective?

@ y-intercept $x = 0$

$f(0) = 0^2 - 12(0) + 20$
$= 20$

$g(0) = 9(0)^2 - 36(0) + 20$
$= 0 - 0 + 20$
$= 20$

Transformations

Inside

x-values change

$f(x+2)$	left 2
$f(x-3)$	right 3
$f(-x)$	reflect over y-axis
$f(3x)$	shrink by a factor of 3
$f(\frac{1}{2}x)$	Stretch by a factor of 2

✱ We do the inverse (opposite) of what is shown to the x-values

Outside

y-values change

$f(x)+2$	up 2
$f(x)-4$	down 4
$-f(x)$	reflect over x-axis
$3f(x)$	stretch by a factor of 3
$\frac{1}{2}f(x)$	shrink by a factor of 1/2

✱ Do exactly what is shown to the y-values